We claim:

1. A trench capacitor, comprising:

a substrate having a trench formed therein, said substrate having a substrate surface and said trench having an upper region and a lower region;

an insulation collar formed in said upper region of said trench;

a dielectric layer lining said lower region of said trench and said insulation collar as a capacitor dielectric;

a conductive filling material filled in said trench and serving as a capacitor plate;

a buried contact beneath said surface of said substrate; and

a doped region below said substrate surface in a vicinity of said buried contact, said doped region having dopants introduced by at least one of an implantation doping, a plasma doping, and a vapor phase deposition.

2. The trench capacitor according to claim 1, comprising a buried plate in said substrate in a vicinity of said lower region of said trench as a further capacitor plate.

3. The trench capacitor according to claim 1, comprising a strap on said filling material above said insulation collar, said strap formed of a further filling material.

4. The trench capacitor according to claim 1, wherein said trench is a bottle-shaped trench having a widened region with a cavity formed in said conductive filling material.

5. The trench capacitor according to claim 1, wherein said conductive filling material above said insulation collar forms a strap to said buried contact with said substrate.

6. The trench capacitor according to claim 1, wherein said buried contact has an interface, and including a tunnel layer at said interface.

7. The trench capacitor according to claim 6, wherein said tunnel layer is selected from the group consisting of an oxide layer, a nitride layer, and an oxinitride layer.

8. A method for producing a trench capacitor, which comprises the following steps:

providing a substrate;

forming a trench with a lower region and an upper region in the substrate;

filling the lower region of the trench with a first filling material;

forming an insulation collar in the upper region of the trench;

removing the first filling material from the lower region of the trench;

lining the lower region of the trench and an inner side of the insulation collar with a dielectric layer as a capacitor dielectric;

filling the trench with a conductive second filling material as a capacitor plate;

providing a buried contact; and

introducing a dopant into the substrate in a region underneath a surface of the substrate in a vicinity of the buried contact by at least one process selected from the group consisting of implantation, plasma doping, and vapor phase deposition.

9. The method according to claim 8, which comprises forming a buried plate in a vicinity of the lower region of the trench as a further capacitor plate.

10. The method according to claim 8, wherein the step of introducing a dopant includes one of an oblique doping and an isotropic doping through an uncovered interface of the buried contact.

11. The method according to claim 8, wherein the step of introducing a dopant includes one of an oblique doping and an isotropic doping through a screen oxide on an interface of the buried contact.

12. The method according to claim 8, which comprises forming a tunnel layer on an interface of the buried contact.

13. The method according to claim 12, wherein the step of forming a tunnel layer includes forming one of an oxide layer, a nitride layer, and a oxinitride layer.

14. The method according to claim 8, wherein the step of introducing a dopant includes vapor phase doping through an exposed interface of the buried contact with one of $AsH_3$ and $PH_3$ at 1100°C, 1 min, and 760 Torr.

15. The method according to claim 8, which comprises forming, above the insulation collar on the conductive second filling material, with a third conductive filling material, a strap to the buried contact.

16. The method according to claim 8, which comprises:

filling the trench with a fourth filling material being selectively removable with respect to the substrate, the insulation collar, and the dielectric layer, after the steps of forming the insulation collar and lining the lower region of the trench and the inner side of the insulation collar with a dielectric layer;

recessing the fourth filling material, the insulation collar, and the dielectric layer for defining an interface between the buried contact and the substrate;

removing the fourth filling material; and

filling the trench with the conductive second filling material.

17. The method according to claim 8, which comprises widening the lower region of the trench relative to the upper region of the trench for forming a bottle shaped trench.

18. The method according to claim 12, which comprises forming a buried strap in the trench.

19. The method according to claim 12, which comprises loading the substrate in a process chamber and performing the steps of providing the buried contact and forming the tunnel layer in a single process sequence without removing the substrate from the process chamber.

20. The method according to claim 18, which comprises loading the substrate in a process chamber and performing the steps of providing the buried contact, forming the tunnel layer, and forming the buried strap in a single process sequence without removing the substrate from the process chamber.

21. A memory element, comprising:

a trench capacitor including a substrate having a trench formed therein, said substrate having a substrate surface and said trench having an upper region and a lower region, an insulation collar formed in said upper region of said trench, a dielectric layer lining said lower region of said trench and

said insulation collar as a capacitor dielectric, a conductive filling material filled in said trench and serving as a capacitor plate, a buried contact beneath said surface of said substrate, and a doped region below said substrate surface in a vicinity of said buried contact, said doped region having dopants introduced by at least one of an implantation doping, a plasma doping, and a vapor phase deposition; and

a selection transistor connected to said trench capacitor via said buried contact.